FROM POLAR EXPLORATION TO MAN ON THE MOON

WHAT CAN WE LEARN FROM THE GREAT EXPLORERS?

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From the moment our ancestors first peered out of the Great Rift Valley to those momentous steps on the Moon, humankind has been curious. "To boldly go...." are words that have resonated with the inquisitive and adventurous for millennia. Historically, only the fittest, healthiest, bravest and most innovative of explorers would venture forth into the unknown - often without any idea what they may encounter. Some planned meticulously, others foolhardily, but all had the overwhelming desire to discover - be it land, cultures, peoples, riches or science. The age of polar exploration occurred in a time of rapid technological advancement, as did the birth of space exploration.

What can we, as healthcare professionals, learn from such great explorers - who dared to live and dream outside their comfort zone and known World? This can be divided into: planning, practice, teamwork, leadership and resilience - familiar to all of us.

PLANNING and PRACTICE

Roald Amundsen was the first person to reach the South Pole. He was known as a meticulous planner, leaving as little to chance as possible. He was professional in his approach to expeditions in a time when the "enthusiastic amateur" was prevalent, and as a result, his expeditions tended to be successful and comparatively stress-free, compared to other contemporaneous ventures. He arrived at the South Pole on 14th December 1911, almost a month before Scott.

His expeditions were well-thought out and as comfortable and well-stocked with supplies and equipment as possible for that period. He learnt from indigenous peoples living close to, or in, the areas of nature he was trying to explore, and was willing to adapt his methods accordingly, staying humble and learning all the time. He also noted very early that the presence of a doctor provided psychological, as well as physical support, to the entire expedition[1]. This was the period of heavy alcohol usage during harsh conditions, and although he allowed alcohol during sea voyages, both he, and probably the greatest of all polar explorers, Fridtjof Nansen, did not allow its use during the overland skiing to the Poles, due to its deleterious effects on performance. All of this ensured that peak performance could occur during the most difficult periods of the expeditions. (However, one stimulant that was widely available and was taken on many polar expeditions at the time was "Forced March" - a cocktail of cocaine and caffeine[2]. This was, of course, before its use and abuse were known.)

Sir Robert Falcon Scott, on the other hand, was not the best planner in the World. He insisted on bringing motorised vehicles and ponies on his Antarctic expedition when others advised him to rely more on dogs for help pulling pulks (sleds). Scott

Image: Human factors may be the difference between success and failure.

Image: Forced March – would definitely be on the WADA list today...

also brought the Norwegian Tryggve Gran with him on his 1911 expedition to teach the other team members how to cross-country ski and pull a pulk - the fact that they were learning this skill once they arrived on the ice, on their attempt to reach the South Pole, is unthinkable nowadays. His ill-fated expedition of 1911, not only arrived at the Pole after Amundsen, but the team tragically perished in a storm within a few kilometres of safety in March 1912[3].

Sir John Franklin's appointment in 1845 (at the age of 59) as Commander of the expedition for the search for the Northwest Passage, was more political than organisational. His route, his crew and his supplies were selected mainly by the British Admiralty, with less overall control from Franklin. Of importance, the tinned food that was sent on-board, having been purchased cheaply by the Admiralty, was heavy with lead in the tins, which probably caused lead poisoning and botulism amongst the crew, all of whom sadly died, marooned in the sea ice[4].

James Cook did not lose a single person to scurvy over his entire expeditions. Having observed that Dutch sailors were less inclined to suffer scurvy than those in the Royal navy, he noticed that one of the differences between them was the fact that they consumed pickled vegetables (including sauerkraut). He therefore brought barrels of sauerkraut on ship but was faced with resistance from his crew who initially refused to eat it. He made sauerkraut a delicacy, only available for the Captain and Officers, and ensured that the crew watched them eat this delicacy. It soon became a source of envy, and sought after, so finally Cook "reluctantly" allowed it to be served to the crew.

Meticulous planning and simulation are, of course, keystones to all of NASA's training. Astronauts spend years in preparation prior to being sent into space. From underwater simulation of spacewalks, centrifuge training to mimic the g-forces of lift-off, multiple parabolic flights on aircraft to experience transient weightlessness (nicknamed the "Vomit Comet) to the NEEMO (NASA Extreme Environment Missions Operation) simulated habitat[5], where astronauts spend several weeks in underwater living conditions and the year-long CHAPEA mission on Earth in preparation for trips to Mars[6], these preparations have been ongoing since Project Mercury. Both Projects Mercury and Gemini astronauts underwent extensive

Image: The MASTIF - which allowed the astronaut to be rotated in three different axes at up to 60 revolutions per minute. Image - NASA.

Image: Historians are divided as to who first said this.

training (including being heated in ovens and being disorientated in a Multiple Axis Space Test Inertia Facility, or MASTIF) to familiarise themselves with what was then the unknown hazards of space. These were essentially planned precursors to the Apollo missions[7], without which the successful moon landings would not have occurred.

Careful planning remains key to any successful expedition or medical venture, with poor planning increasing the likelihood of failure in all fields.

TEAMWORK

Sir Ernest Shackleton hand-picked his teams to go with him to the Antarctic. He described the qualities he looked for in an explorer as "*in order of their relative importance: first optimism, second patience, third physical endurance, fourth idealism and fifth courage*"[8]. These qualities remain as important now as when he wrote them, and certainly applies to astronauts as they leave the Earth for prolonged periods of time, living in very small, cramped environments close together.

During the long polar winter, when ships were iced-in, or when expedition members were camped on the ice, a variety of games, reading, journal writing, plays and soirée evenings helped while away the time. This not only helped maintain morale, but also brought team members together - distraction from hostile elements and a shared common goal, however temporary, increased team bonding. As Shackleton stated: optimism and patience were key to polar success. Being able to endure physical and psychological hardship for months, sometimes years at a time without becoming demoralised, disheartened and disengaged is a quality that cannot be overstated, maintaining and enhancing team dynamics in such times of difficulty.

Along with teamwork comes self-sacrifice. Probably the most famous example of this in polar exploration was on Scott's expedition to the South Pole. After weeks of traversing the Antarctic ice, and close to exhaustion, Captain Oates, weak, frost-bitten and starving, realising that the expedition was short of food and that he was a liability, walked out of the communal tent during a storm to certain death with the immortal words, "*I am just going outside and may be some time*". He sacrificed himself in the hope that his team would survive[3] - the ultimate team player.

Apollo 13, the 1970 Apollo mission that failed to fulfil its mission to the Moon, has been hailed as "NASA's finest hour"[9] epitomising the incredible teamwork and high performance required to bring a stricken, damaged spaceship and its three astronauts, more than a quarter of a million kilometres out in space home to safely land on Earth. The problem started 56 hours

Image: Shackleton's crew playing football on the ice with the Endurance, stuck in the sea ice in the background

Image top: Shackleton (figure on left) and his crew, pulling boats over the ice.
Image left: The Endurance, stuck in the sea ice.

into the mission, at approximately a third of the way to the Moon when an oxygen tank exploded on the command module, venting oxygen into space. This caused problems with the entire spacecraft, causing emergency shutdown of all non-essential systems and the use of the two-man lunar module as an emergency "lifeboat" for the three-man crew, whilst it slingshot around the Moon in order to accelerate back to Earth in a survival epic lasting several days. There were navigational, physiological and psychological crises that required incredible teamwork, both within the Apollo capsule, back at Mission Control and between the two to occur. It is during this epic that flight controller Gene Krantz allegedly said, "*failure is not an option*".

One example of such teamwork involved a catastrophic build-up of CO_2 inside the lunar module, requiring out-of-the-box thinking to overcome this issue. A makeshift CO_2 extractor had to be made and the solution sent to the astronauts in space. The solution involved a sock, a plastic cover from an instruction manual and duct tape. In order to achieve this, the ground control team went through all the spacecraft manifesto that they had documented on checklists - since they had to use whatever the astronauts had with them, highlighting how useful checklists were. In fact, without checklists, the whole Moon landings would not have occurred, and they remain a vital part of NASA's planning today.

Additionally, Buzz Aldrin, the second astronaut on the Moon, has subsequently stated that the most useful thing to take into space remains duct tape.

LEADERSHIP

Shackleton's leadership during his failed 1914-1916 attempt to cross the Antarctic has become legendary. Having set off from the UK in a specially strengthened ship - the Endurance - the ship became locked in the Antarctic sea ice and was eventually destroyed and sank as the ice shifted and crushed the ship's hull.

Shackleton then led his men across the ice, pulling three small boats over several months to open water, living mainly off seal.

Once they reached the edge of the pack ice and found open water, they then set sail the ~500km trip to Elephant Island using basic navigational aids only, where he left most of the crew and set sail with five crew in a tiny sailboat across the Drake Passage (the most dangerous seas in the World) navigating to South Georgia, through storms and huge seas, with incredible skill. The trip was more than 1200Km and took 17 days. He subsequently landed on the uninhabited side of the island, and had to traverse the snow and glacier-filled interior mountain range to get help - a feat not repeated until the great Reinhold Messner achieved it in 2000, such is the difficulty. Shackleton arrived at the whaling station on the far side of South Georgia and returned to Elephant Island, rescuing his crew - with not a single explorer lost[10]. (Unfortunately, after rescue, most of the crew who had survived unspeakable hardships on the ice volunteered to join the war effort and were killed within months of arriving on the Western Front. Shackleton's leadership contrasts markedly with the leadership of the British army during the First World War. In fact, Alan Clark wrote that during the war, the British army was made up of "*lions led by donkeys*", a phrase allegedly originally attributed to the German military strategist, General Erich Ludendorff[11]).

Leadership in an emergency must be hierarchical, but in routine situations, a more collective, participatory, supportive style of leadership, allowing shared decision-making, is more effective for good teamwork[12]. Being able to move between these leadership styles as situations changed, with a high degree of emotional intelligence, allowed Shackleton to relate to each team member individually and collectively, getting the best out of the individual and also the team. He has surely gone down as one of the greatest leaders in exploration.

The Moon landing on 21st July 1969, is one of humankind's greatest achievements - but it almost ended in disaster. As the landing module (the "Eagle") was entering the final stages of its landing sequence, 2 alarms suddenly went off in the tiny lunar module. These alarms - "1202" followed by

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"1201" were unknown alarm sequences with no known cause. This, coupled with the fact that the module had overshot its proposed landing site meant that Commander Neil Armstrong had to deal with these alarms, whilst attempting to locate a new landing site never surveyed before, whilst running rapidly out of fuel. His calmness under such intense pressure is a mark of true leadership - another learning point. This stemmed from his personality, knowledge, skill- and mind-set but also from the years of practice that he had undertaken prior to the mission. He landed the Eagle safely on a new site in the Sea of Tranquility with just seconds of fuel left, and achieved his "one small step", propelling him into the history books. A true leader, he was able to take control when the situation demanded it, remain calm and navigate a potential catastrophic situation without panic.

RESILIENCE

Adversity is par for the course in exploration. For polar explorers, being trapped in sea ice for months on end, or being unable to leave camp due to terrible storms which subsequently made traveling very difficult were to be expected. The ability to overcome these difficulties and re-focus on common goals and opportunities was, at times, the difference between success and failure. In 1888, Nansen, with a team of five, was the first to traverse Greenland - his motto being "*the west coast or death*"[13] since he landed on the east coast with no return possible with the only permanent settlements at the time being on the west coast. They struggled over the ice, were stranded on floating ice floes, almost fell into crevasses and were attacked by Polar bears. But they survived and the knowledge that the only way was forward was a great motivator to success, bringing all team members together to focus on this common goal. Nansen learnt from these hardships, with subsequent expeditions benefiting from these harsh lessons.

NASA is an organisation with great resilience in overcoming adversity. The terrible fire that occurred on the launch pad of Apollo 1, in 1967, when testing the spacecraft was one example. A spark due to faulty wiring, worsened by an oxygen enriched environment, caused a catastrophic fire that killed astronauts Gus Grissom (second American in space), Edward White and Robert Chaffee who were trapped inside the command service module at the time. A thorough root cause investigation highlighted several errors (including having 100% oxygen in the spacecraft with flammable material and a difficult emergency release hatch design). NASA learnt from this, altering its spacecraft design and protocols to minimise the interactions between pressure, oxygenation and fire - without which the Moon landings would probably not have happened. Today's astronauts are still benefiting from the lessons learnt from this tragic episode.

We never stop learning - and some of the best lessons come from mistakes and adversity. The astronaut Kjell Lindgren, who has spent a year on the International Space Station said, "*failure is not an option, it's a necessity*" since it allows us to improve and decrease error. However, he also stated that spending too much time mulling over mistakes can be detrimental - "*by beating yourself up over mistakes, you are impeding your ability to be effective now*". We can find lessons on a daily basis - the late Professor Robin Touquet was fond of saying that "*with every patient there comes a learning opportunity*", a sentiment we can all appreciate.

CONCLUSION

The great age of polar exploration and the birth of space exploration are littered with incredible stories of endurance, innovation, hardship, survival and, at times, disaster. As the philosopher George Santayana once said, "*those who cannot remember the past, are condemned to repeat it*". These explorers have taught us that proper planning and preparation with prior practice prevents poor performance. The use of checklists is also incredibly useful. A team works best when individuals know and respect each other and each other's opinions, being able to agree or disagree without tension or anger, allowing them to work together effectively. A leader must be calm under pressure, have sufficient emotional intelligence, know their team and be able to alter leadership styles according to the individual and the situation. And above all, remember to take duct tape ....!

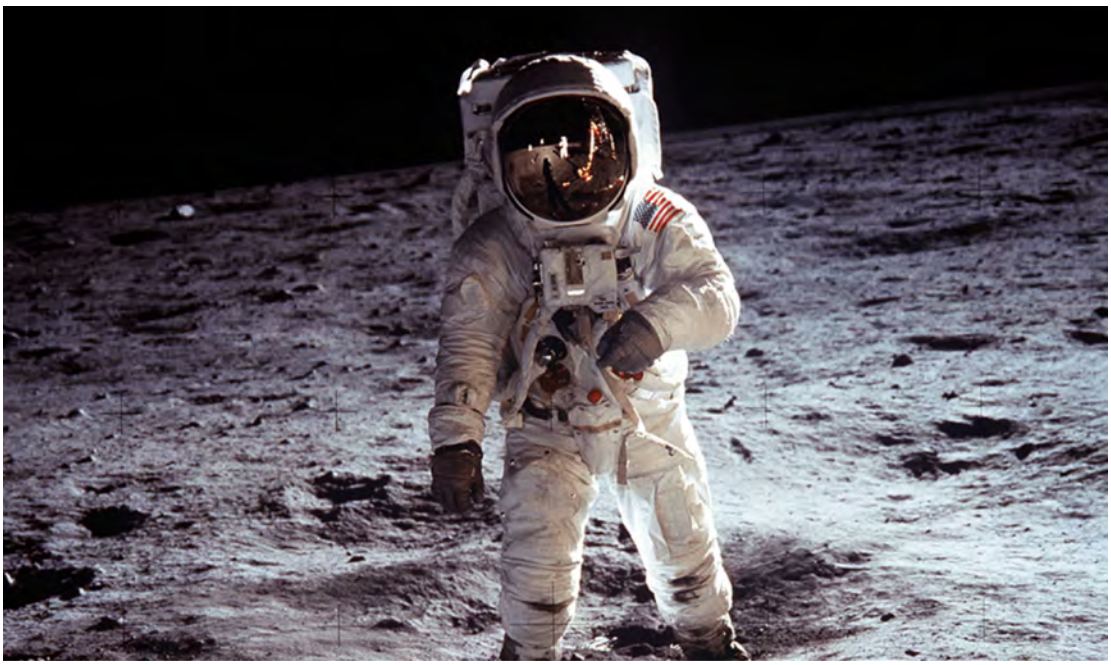

Image: Buzz Aldrin - Apollo 11 - July 20th 1969 - photo taken by Neil Armstrong.

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